ASSOCIATION FOR **MAXIMUM SERVICE TELEVISION, INC.**

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May 31, 2007

Via Electronic Filing

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12 Street, SW
Washington, DC 20554

Re: Notice of Ex Parte Communication,
ET Docket Nos. 04-186, 02-380

Dear Ms. Dortch:

On May 30, 2007, Bruce Franca and Victor Tawil of the Association for Maximum Service Television (MSTV) met with Ms. Monica Desai, Mr. Andrew Long, Mr. John Gabrysch, Mr. Keith Larson and Mr. John Wong of the Media Bureau and Mr. Julius Knapp and Mr. Alan Stilwell of the Office of Engineering and Technology with regard to the above-captioned proceeding.

MSTV's most recent comments with regard to the OET Receiver Report prepared by Mr. Stephen R. Martin were discussed. In particular, the Report's description of the differences in interference to analog and digital television reception; its findings with regard to the extent weak signal conditions occur within a TV station's contour; and, its findings with regard to adjacent channel DTV receiver interference rejection performance. Receiver test results from the University or Kansas and the Canadian Research Centre were also discussed.

The attached presentation was provided.

Respectfully submitted,

Bruce Franca
VP, Policy and Technology

cc: Ms. Monica Desai
Mr. Andrew Long
Mr. John Gabrysch
Mr. Keith Larson
Mr. John Wong
Mr. Julius Knapp
Mr. Alan Stilwell

MSTV

White Spaces Presentation

May 30, 2007

Some Useful Terms

- DTV Station's Protected or Noise Limited Contour (41 dBu for UHF)
- Threshold of Visibility (TOV) of DTV Receiver (~ -84 dBm)
  - Minimum signal level at which DTV Receiver still provides "perfect picture"
- Decibels or dB
  - Simpler way to handle large differences in numbers

MSTV DTV and Analog Interference Different

- Analog
  - Interference can increase by about 8 dB before viewer "sees" difference
  - Interference can increase by about 20 to 30 dB before picture "unusable"

Normal Analog Picture

Analog TV with Varying Interference

MSTV DTV and Analog Interference Different

- Digital
  - Most DTV sets went from perfect picture and sound to ***no*** picture or sound in 1 dB
  - Several DTV sets went from perfect picture and sound to ***no*** picture or sound in 1/10th of a dB

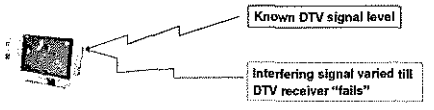
Normal Digital Picture

DTV with Interference

- Suggests conservative and cautious approach to interference

[See OET Report at 15.2-15-3 for analog/digital description]

MSTV D/U Ratios/FCC Receiver Tests



- "D" stands for "desired" signal (in this case, the DTV signal)
- "U" stands for "undesired" signal or interfering signal
- D/U ratio is the point where harmful interference begins
  - Positive number means that the desired signal must be greater than the undesired (e.g., co-channel interference)
  - Negative number means the undesired signal can be bigger than the desired (e.g., first or second adjacent channel interference)

General Findings

- FCC Report notes that DTV receivers are at their most vulnerable when operating at low desired signals
- FCC Report observes that low desired signals can occur over significant portion of TV service area, due to:
  - Distance from transmitter
  - Use of indoor antennas
- FCC Report noted receivers most vulnerable to interference on number of channels (N±1, N±2, N-3, N-4, N-6, N+7 and from multiple interfering signals)
- This Presentation concentrates on co- and first adjacent channel interference only

D/U Ratios/FCC Receiver Tests

Federal Communications Commission FCC 04-113

Type of station	Protection ratios		
	Channel separation	D/U ratio (dB)	Propagation curve
Analog TV, Class A, DTV, translator and booster	Co-channel	34	F(50,10)
	Upper adjacent	-32	F(50,50)
	Lower adjacent	-14	F(50,50)
Digital TV and Class A	Co-channel	23	F(50,10)
	Upper adjacent	-28	F(50,50)
	Lower adjacent	-28	F(50,50)

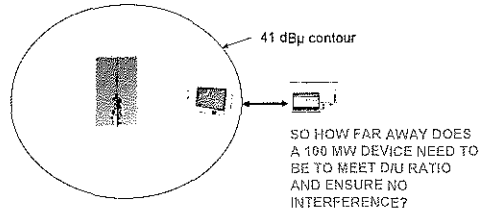
31. We propose to require that these service and protection criteria be used in conjunction with appropriate computational software, including use of the Commission's propagation curves, and a television station engineering database to develop the coded signal information on available channels for unlicensed personal/portable devices and for coordination and deployment of unlicensed fixed access devices. All unlicensed operations in the TV bands would be subject to the general requirements of Part 15 for not causing harmful interference and would be required to ensure that the D/U ratios for acceptable interference in the above Table are always maintained. We also seek comment on

- FCC proposed same protections as contained in §73.623 for television operations
- FCC Receiver Tests did not include co-channel tests

Co-channel Interference Distance

Co-channel Interference Distance

- No party disputes fact that a TV band device must operate outside protected contour of TV station



SO HOW FAR AWAY DOES A 100 MW DEVICE NEED TO BE TO MEET D/U RATIO AND ENSURE NO INTERFERENCE?

Co-channel Interference Distance

- FCC proposed co-channel D/U is +23 dB
- TOV for most DTV receivers is about -84 dBm
- Interfering signal must be 23 dB lower (+23 dB D/U) than -84 dBm signal or -107 dBm
- Calculate interference distance:
  - 100 mW is the same as +20 dBm
  - To go from +20 dBm to - 107 dBm need a propagation loss of -127 dB
- R^4 propagation model yields separation distance of 10 kilometers (radio horizon would be 15 km)

Intel's Link Budget

Step 1. Determine the separation distance needed between a 100 mW unlicensed device and a potential victim receiver.

Link Budget	Value
Unlicensed device transmit power (100 mW)	20 dBm
Receiver interference protection threshold	-107 dBm
Loss needed between unlicensed device and victim receiver (20 dBm – [-107 dBm])	127 dB
Average building losses	6 dB
Off-axis DTV Antenna gain	-14 dB
Loss needed to be attributed to path loss at 600 MHz (127 dB – 6 dB – 14 dB)	107 dB[1]
Free space interference range distance at Grade B service contour	3 km

See Comments of Intel Corporation dated 11/30/2004

- Building loss assumes unlicensed device is indoors near window
  - Device could be outside
- Off axis DTV antenna gain of -14 dB assumes TV antenna is always pointed 180 degrees completely away from unlicensed device
- 8 km "interference distance" somewhat optimistic

Co-channel Interference Distance

- Co-channel 100 mW (+20 dBm) device must be MILES outside TV station's protected contour to protect TV viewers!
  - Intel suggested interference distance of 8 km or 5 miles. (This is an area (πr^2) of 75 sq. miles.)
  - MSTV/NAB, IEEE and others suggest that actual interference distances are even greater (about 10-15 km)
- Co-channel interference isn't a same home or only a nearby neighbor problem

Personal/Portable Devices

What's the Personal/Portable Issue?

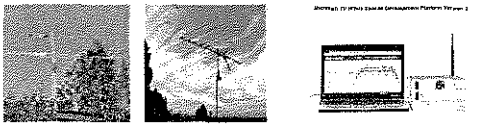
- Device Coalition claims sensing at 30 dB better than DTV receiver will protect viewers
  - WILL SHOW SENSING CLEARLY DOESN'T WORK
- Device Coalition claims adjacent channels can be used within TV service area
  - FCC/OET MEASUREMENTS SHOW THIS CAN'T BE DONE

Bottom Line Concerns:
INTERFERENCE TO OUR VIEWERS AND OUR ABILITY TO PROVIDE NEW SERVICES

What's the Personal/Portable Issue?

- Device Coalition claims sensing at 30 dB better than DTV receiver (-114 dBm) will protect viewers
- Need to Compare "Apples to Apples"
- Device sensing isn't really 30 dB "better" when physical differences taken into account
  - Gain of antennas
  - Height of antennas
  - Location device
    - Device is suppose to be beyond contour
    - Indoor vs. outdoor
  - Propagation paths

Size Matters



- Antenna Size/Gain Matters
  - Large Outdoor TV Antenna Gain can be 10 dB or more
  - TV Band Portable Device Antenna Gain 0 dB or less
- This means if same signal received by DTV receiver with outdoor antenna and the TV band device – the TV band device's signal will be 10 dB less!
- 30dB – 10 dB = ONLY 20 dB better than DTV receiver

Height Matters

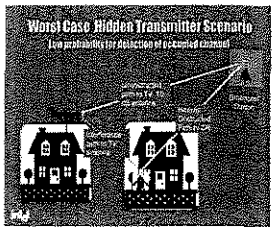
- TV antenna typically assumed to be at 10 meters (can be more)
- Portable device typically assumed to be at 2 meters
- Height difference between 10 and 2 meters is 7dB
- (30 dB – 10 dB) – 7 dB = ONLY 13 dB better than DTV

Location Matters

(Outdoor vs. Indoor/Beyond contour)

- Outdoor vs. Indoor signal can easily be 15 dB or more
  - NAF measured indoor data showed that the "*average variation* across rooms for a given frequency channel was 19.8 dB" and variation between nearby homes was 30 dB
  - Signals varied from predicted "outdoor" values by 15 to 55 dB
  - (30 dB – 10 dB – 7 dB) – 15 dB = SENSING FAILS!!
- Device suppose to be *beyond* contour by 8 to 15 km
  - (30 dB – 10 dB – 7 dB – 15 dB) - another 3 to 7 dB = SENSING FAILS!!

But Wait There's More!



- Sensing must also work for "hidden node" problem
  - DTV signal received by TV Band device can be blocked because of other buildings, terrain, etc.
- Hidden node requires additional margin
- Sensing at 30 dB already fails simple unobstructed model!

Intel Presentation to FCC 11/1/2004

What Does the Record Show?

NAF's Indoor Measurements

21.7 dB — 26.8 dB

CH	Residence1				Residence 2				Residence3			
35	-71.2	BR2	-85.2	LR	-83.4	BR1	-79.4	LR	-82.6	KIT	-93.2	FR
53	-76.7	BR3	-98.4	DN	-71.8	BR3	-84.8	BR2	-90.6	KIT	-98.6	LR
60	-74.4	BR4	-92.6	BR5	-69.6	LR	-81.0	FR	-91.2	KIT	-95.4	BR2
65	-71.2	BR1	-88.7	DN	-88.7	BR3	-78.0	BR2	-85.2	KIT	-92.2	BR1

- All three residences are located within one mile of each other and have clear line of sight to the TV transmitting antenna about 25 miles away
- "Average variation across rooms for a given frequency channel was 19.8 dB" – page 34 of NAF study
- Up to 30 dB difference between houses (L-R and Tirem predictions within 1 dB on any channel between all three residences)
- F(50,90) predicts about -34 dBm (-45 dBm for pilot) on ch. 36 for all three homes – indoor measurements 15 to 55 dB different

Other Measurements

- CEA measured signal strength difference between roof top antenna and indoor reception
- 10% of samples tested by CEA had a signal strength difference in the 39 to 43 dB range
- 1995 measurements by MSTV showed that signal levels less than -116 dBm can occur within TV station's service area

Intel's Original Sensing Proposal

Minimum Useable DTV Signal Strength	**-83 dBm**	
Required Protection Ratio (dB)	**-23 dB**	
Difference in Antenna Gain (dB)	**-10 dB**	
	Intel's proposal	**Numbers from Intel's submissions**
Difference in Antenna Height (dB)	**-23 dB**	**-7 dB**
Building Losses (dB)		**-5.7dB (8.6 dB SD)**
Multipath Losses (dB)		**-19 dB***
Detection Signal Level	**-118 dBm**	**-126.7 to -135.3 dBm**

*Intel states that Bullington suggests 19 dB for 99% of occurrences over 50 to 70 km path (path actually over 90 km for typical TV station).

Questions for OET

- MSTV/NAB, IEEE, Motorola all suggested that Intel's proposal of -118 dBm wouldn't work
  - Not addressed by FCC's NPRM
- How does OET's proposal of -116 dBm work?
  - Cite to IEEE 802 requirement but IEEE 802 said only works with geolocation
- How can Coalition's device propsal of -114 dBm work?

What's the Personal/Portable Issue?

- ✓ Sensing at 30 dB better than DTV receiver will **NOT** protect viewers and is not sufficient to address variability in signal levels that can be present throughout TV station's service
  - ✓ SHOWED SENSING CLEARLY DOESN'T WORK
- Device Coalition claims adjacent channels can be used within TV service area
  - FCC/OET MEASUREMENTS SHOW THIS CAN'T BE DONE

Adjacent Channel Interference

- FCC measured Desired-to-Undesired (D/U) ratios for eight "best" DTV receivers
- FCC proposed 10 meters as interference distance
- Use interference distance and measured D/U values to calculate where potential interference can occur

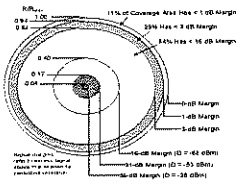
Adjacent Channel Interference

- What is the undesired signal level of a 100 mW device at 10 meters?
- NAF computes signal level of a 100 mW device at 10 meters:

100mW =	20 dBm
10 m Free Space Loss @ 600 MHz =	- 48 dB
Signal Strength at 10 m =	- 28 dBm

- FCC's "Best Receiver" had a measured D/U ratio of -40.1 dB at -68 dBm level
  - For U = -28 dBm then D = -68.1 dBm
  - If DTV signal greater than -68.1 dBm then no interference
  - If DTV signal less than -68.1 dBm then interference occurs
- FCC Report states that level of -68 dBm or less represents 84% of typical DTV station's service area

DTV Signal Strength From FCC Report



R = range from the broadcast antenna to the TV reception antenna. RMAX = R at the edge of coverage

Figure 2-3 Relationship Between Signal Excess and Coverage Area

- OET Report suggests that 84% of the service area of a typical DTV station has 16 dB signal margin or less
  - DTV signal at 20 miles is -68 dBm (for station with 50 mile coverage)
  - 100 mW device at 10 meters is -28 dBm (*i.e.*, 40 dB or 10,000 times more power than DTV signal)
- OET Report also notes DTV signal can be lower than "predicted" if indoor antenna used

Test Results for All Receivers

	D/U for N+1 at -68 dBm	DTV PS values ≥ begins	N+1 Interference Area (% of TV Service Area)...	D/U for N+1 at -58 dBm	DTV PS values ≥ begins	N+1 Interference Area (% of TV Service Area)'	Free Space Interference Distance at Edge of DTV Contour...
FCC Best Receiver	-40.1	-68.1	84%	-42.1	-70.1	80%	56 meters
FCC Worst Receiver	-37.9	-65.9	87%	-37.9	-65.9	87%	112 meters
FCC 2nd Worst	-36.6	-66	87%	-36.3	-66.3	87%	106 meters
FCC Median	-35.3	-67.3	85%	-39.7	-67.7	84%	80 meters
ISE Receiver #1	-34	-63	97%	-31	-59	94%	502 meters
ISE Receiver #2	-35	-58	94%	-39	-67	85%	178 meters
ISE Receiver #3	-30	-58	95%	-29	-57	94%	223 meters
CRC Receiver #1	-29.7	-57.7	95%	-27.5	-55.5	94%	282 meters
CRC Receiver #2	-34.2	-62.2	92%	-37	-65	89%	126 meters
CRC Receiver #3	-36.7	-64.7	88%	-36.5	-64.5	89%	100 meters
CRC Receiver #4	-37.1	-65.2	88%	-39.0	-67	85%	80 meters
CRC Receiver #5	-37.7	-65.7	88%	-37.0	-65	88%	100 meters

Adjacent Channel Interference

- FCC test results show a personal/portable device could cause interference to DTV viewers over 80 to 87% of a TV station's service area
- Results for DTV receivers tested by University of Kansas and Canadian Research Centre show additional interference possible
- Interference distances at edge of contour range from 56 meters to hundreds of meters
- Part 15 is predicated on "no interference" standard
  - Potential interference to 80 to 97% of TV stations service area clearly does not meet this standard

Bottom Line

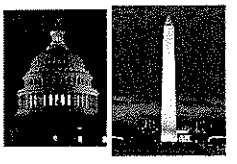
- Sensing at 30 dB below doesn't work
- Adjacent channel operations will cause interference
- Personal/portable devices should NOT be permitted
- Fixed/base station control approach based on geolocation and data base can work and is better solution to rural broadband

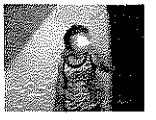
Coalition Statements

TV Band Device Proponent Arguments

- How can a very low power 100 mW device cause interference to a high power TV signal?

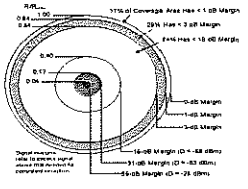
A Simple Analogy





- What will look brighter -
  - The Capitol or Washington Monument at miles away
  - Or the light held by the lady on the right at a few feet away?

DTV Signals Can Be Much Weaker than Signals from 100 mW Devices



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TV Band Device Proponent Arguments

- Interference from other high power adjacent channel TV stations will be much worse than interference from adjacent channel TV band devices

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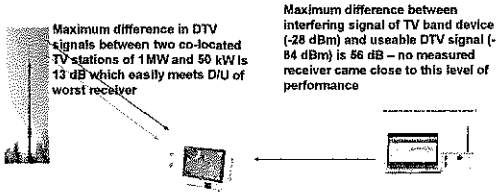

TV Band Device Proponent Arguments

- DTV receivers that meet "blue rack" performance won't receive interference

TV Band Device Proponent Arguments

- DTV receivers that meet ATSC A-74 performance recommendations won't receive interference
- FCC adjacent channel test results exceed A-74 specifications for adjacent channel performance
  - Results showed potential interference for 80 to 87% of TV station's service area